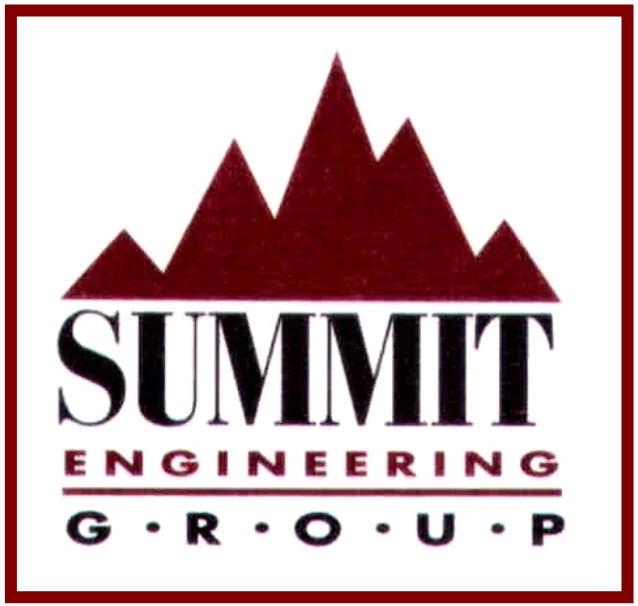
Challenges to Integrated Cost and Performance Analysis



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Preface

- This briefing focuses on the challenges of performing integrated analyses across the traditionally ‘stove-piped’ analytic environments of systems engineering/ engineering design, system performance modeling, and system cost estimation

Discussion Topics

- Background
- Historical Analytic Shortcomings
- Modeling Environment
  - Cross-domain mapping dilemma
  - Integrated Modeling Workflow
- Effects of Integrated Analyses
  - Performance and Capability-based Costing Challenges
  - Potential Approach
  - Why LCC / Hour?
  - Cost Estimation Data Flow
  - Calculating Cost of Capability
  - Other Challenges
- Lessons Learned / Insights
- Questions

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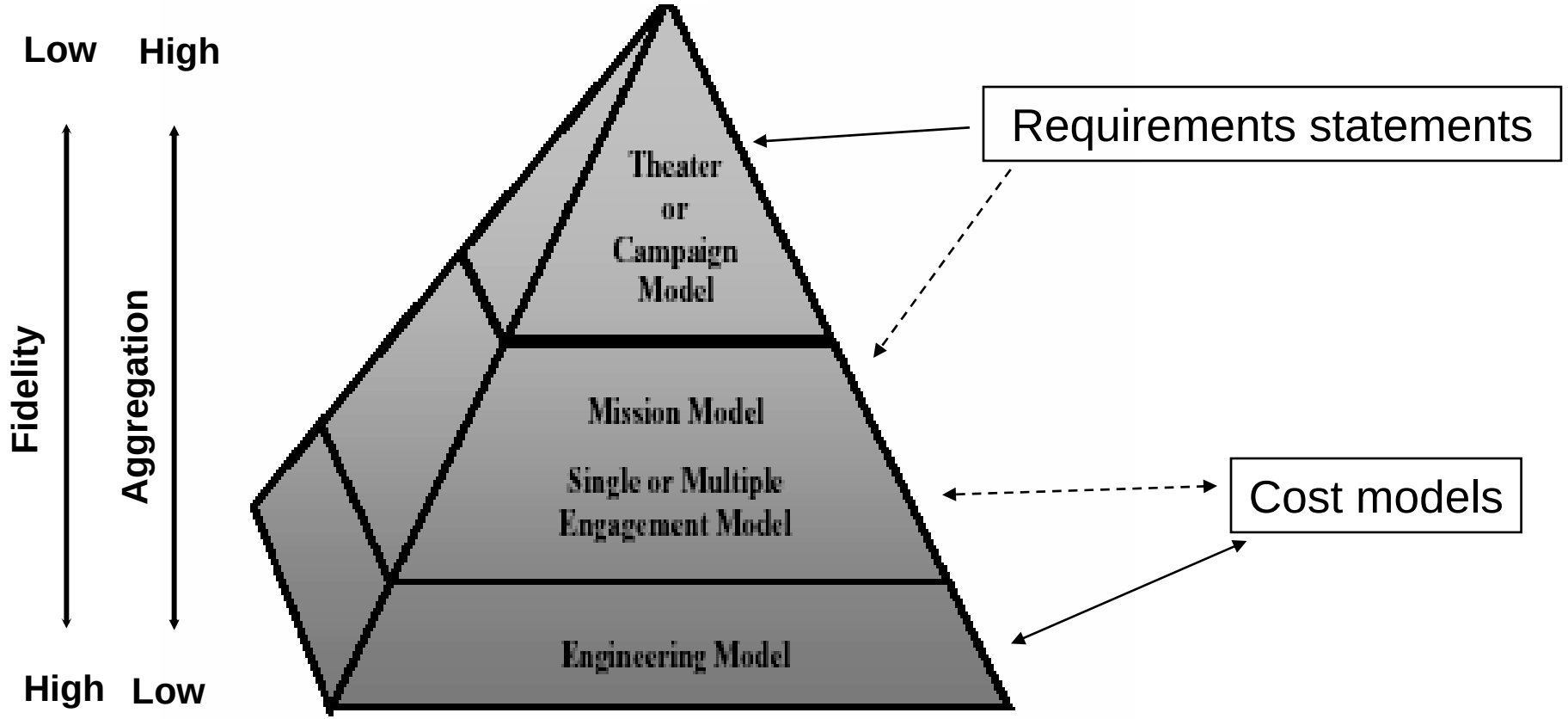
Background

- Recent Summit Engineering Group projects focused on creating integrated analytic frameworks that utilize applicable cost, performance, and engineering models
  - Office of the Deputy Assistant to the Secretary of the Army - Cost and Economic Analysis (ODASA-CE) Integrated Performance and Cost Model (IPCM) Program
  - Naval Air Systems Command (NAVAIR) Decision Support System (DSS)
- Significant challenges to this approach
  - Establishing communications between design engineers, performance modelers, and cost analysts throughout program life cycle
  - Conceptual/Theoretical differences between Performance-based and Capability-based costing
  - Often the classified performance data is housed in a different environment than the typically unclassified cost data
- Ultimate goal is to provide decision makers and stakeholders with better information, earlier in acquisition cycle

Historical Analytic Shortcomings

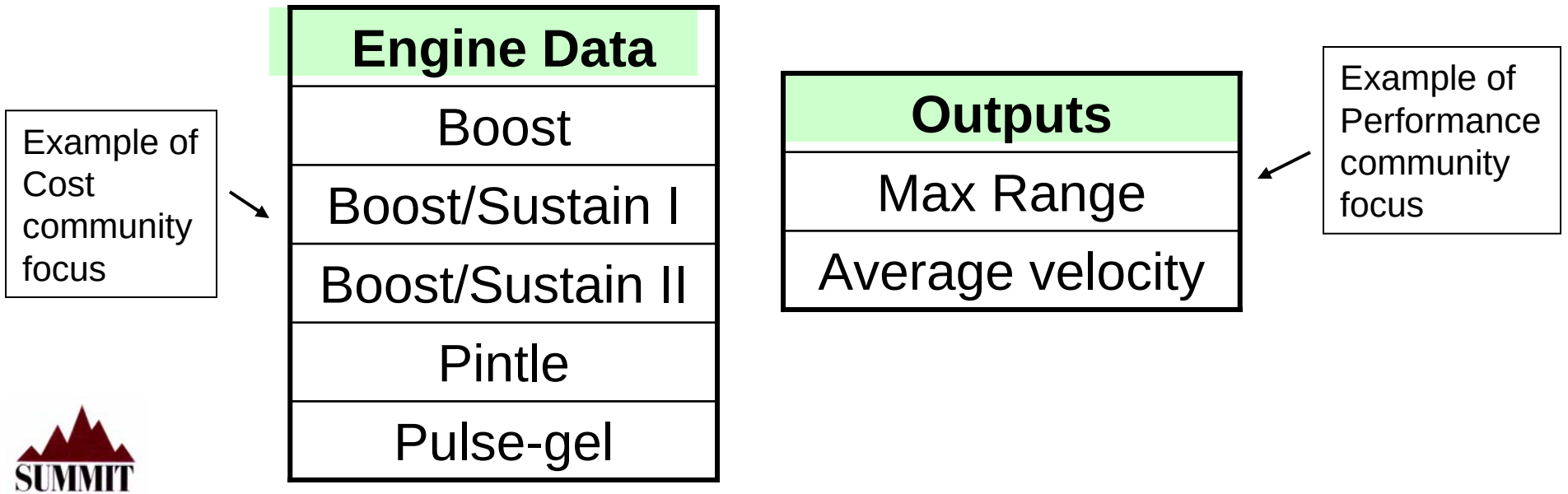
- Cost and performance analyses are 'stove-piped' and often disjointed
- System-level cost-performance trades sometime happen too late to implement (if they happen at all)
- Collaborative studies are time-consuming and usually only bilateral (involve only two modeling perspectives)
  - Cost/Engineering trades
  - Engineering/Performance trades
  - Engineering is link for cost/performance trade studies
- Cost analyses (POEs, ICEs, CAIG estimates) are often not 100% correlated with system configuration(s)

Modeling Environment

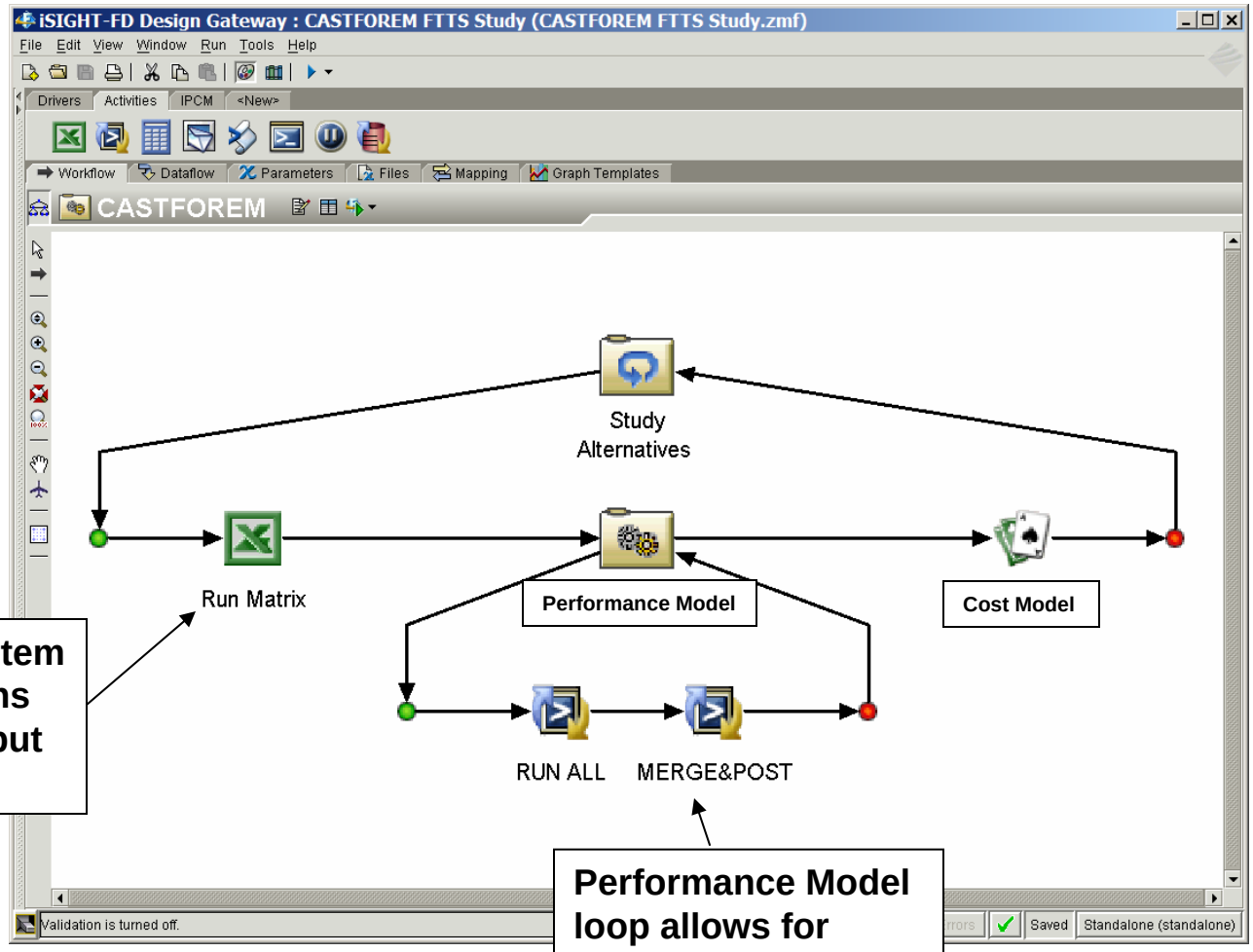


Cross-Domain Mapping Dilemma

- Engineering data feeds engineering models and generates Outputs
- Outputs serve as inputs to Performance model(s)
- Cost model utilizes engineering data/system configuration to generate costs



Integrated Modeling Workflow



Matrix of system configurations serves as input to models

Performance Model loop allows for multiple iterations

Effects of Integrated Analyses

- Focus discussion on feasibility and merits of Performance-based and Capability-based Costing versus current Engineering/Design-based Costing
- Rigidity of legacy cost and campaign models may not support Performance and Capability-based Costing paradigm
  - Need to invest in intellectual capital to leverage models currently in use
  - Need to invest in new data and new models
- Facilitates transition of analyst perspective from single-theater, single-conflict to global force structure

Performance and Capability-based Costing Challenges

- Different than the traditional idea of “system cost”
- Creates a need for new CERs that are more aligned with mission/campaign model inputs
  - Kills/hr, area coverage, etc.
- Reasonableness and traceability of cost data becomes a real requirement

Potential Approach

- Given "ground truth", can calculate level of effectiveness
  - For example, percent of targets detected
- Given specified fixed-level of effectiveness (goal), time to achieve a common level will vary by alternative
- Use ***time*** to quantify both cost and effectiveness
  - LCC per hour x hours to achieve desired level of effectiveness

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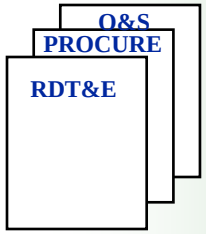
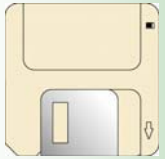
Why LCC / Hour?

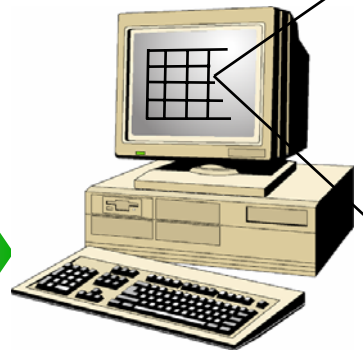
- LCC / Hour captures not only O&S, but also all related R&D/Acquisition/Construction investments required to realize the capability of interest
- Some applicable LCC / Hour adjustments
  - Vignette attrition
  - Weapon expenditures
  - Multi-mission platforms
  - Global services
- Evens “playing field” between legacy and new systems

Cost Estimation Data Flow

LCC Data Sources







System N - Capability X
RDT&E: $ Total
Procurement: T_1 & Slope (Baseline)
T_1 & Slope (P^3I)
O&S: $/FH, FH/YR

System N

Package #	Configuration	Qty	RDT&E $	Procurement $	O&S $	Total LCC $
1		0	$ 0	$ 0	$ 0	$ 0
2	• Current Baseline	10	$ 118	$ 361	$ 960	$ 1,439
3	• Current Baseline	10	$ 118	$ 361	$ 960	$ 1,439
4	• TS II Replacement • IR Upgrade • Comms Upgrade	10	$ 122	$ 389	$ 960	$ 1,471
5	• Current Baseline	15	$ 118	$ 526	$ 1,400	$ 2,044
6	• Same as package #4 • CARS Interface capability	26	$ 124	$ 968	$ 2,384	$ 3,477
7	• More CDL bandwidth • Current Baseline	26	$ 118	$ 896	$ 2,384	$ 3,398
8	• Same as package #6 • Heavy fuel engine • SIGINT, MTI Sensors • HSS/FPRS Sensors	64	$ 174	$ 2,880	$ 6,048	$ 9,102
9	• Same as Package #8	64	$ 174	$ 2,880	$ 6,048	$ 9,102
10	• Same as Package #8	64	$ 174	$ 2,880	$ 6,048	$ 9,102

Component N

	Cap 1	Cap 2	....
System 1	x		
System 2	x		
Total			

Architecture N

	Cap 1	Cap 2	Cap 3	....
Component 1	x			
Component 2			x	
Component 3		x		
..				

Calculating Cost of Capability

- Develop System LCC estimate
  - R&D (Actuals for legacy systems and some new systems)
  - Acquisition/Construction (Actuals for legacy systems)
  - O&S (Historical for legacy systems)
- Convert all LCC estimates to common $ basis
- Calculate LCC/hr for each platform/system as configured
- Apply LCC/hr for length of time each platform/system plays (multiplier)

LCC/hr = LCC / (# units * annual operating hrs * assumed lifetime)

$$\text{Cost of Capability} = \sum \text{LCC/hr}_{\text{entity}} * \text{hrs employed}_{\text{entity}}$$

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Other Challenges

Analytic Issue	Example Decisions	Cost Characteristics
New System(s)	• New/Niche capability • Redundant capability @ lower cost • Introduce Automation	• Ill-defined technical baseline • High uncertainty
Mods to Existing System(s)	• Add new capability • Improve capability	• Focused impacts • Lower uncertainty
Eliminate System(s)	• Phasing out capability provider • Exchange cost stream with new system(s)	• Focused impacts (vs. entire estimate) • Political Issues

Lessons Learned / Insights

- Engineering Models
  - Not built for collaboration
  - May require significant simplifying assumptions
- Models are currently designed to be used within current stove-piped analytic process
  - Adapting models for integration may require *invasive changes* to model
  - Proliferation of integration environments may lead to culture changes resulting in models that are less closed and stove-piped
- Integrated modeling is more about analysis than about integration
- Cultural roadblocks threaten collaboration
  - Too much reliance on SMEs
  - Data sharing issues
  - Lack of early communication
- Classification issues must be addressed ASAP
- Benefits of integrated modeling environments
  - Can help break stove-pipes
  - Get engineers involved early in decision process
  - Help provide requirements traceability
  - Enable analysts to “see” the whole trade space
  - Encourage development of CERs

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Questions?

Presenter Biographies

- Mr. Kurt Willstatter
  - Sr. Principal at Summit Engineering Group
  - Certified Cost Estimator/Cost Analyst (SCEA)
  - BA Biology (Texas A&M)
  - MS Operations Research (Naval Post Graduate School)
  - 15+ years of systems engineering, modeling & simulation, cost estimation experience
  - 20 years of Navy operations and systems engineering
- Mr. Richard “Andy” Campbell
  - Associate at Summit Engineering Group
  - Certified Cost Estimator/Cost Analyst (SCEA)
  - BS Mathematics, BA Economics (Rhodes College)
  - 4+ years of cost estimation, program analysis/management, and effectiveness modeling experience

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